Circular No. 6078
August, 1928.

SEP 17 1928

INFORMATION CIRCULAR

DEPARTMENT OF COMMERCE----BUREAU OF MINES

RAILROAD FUEL OIL CONSUMPTION IN 1927[1]

By Arthur Huber Redfield[2]

This study of railroad fuel oil consumption in 1927 is a continuation of the study of Railroad Fuel Oil Consumption in 1925, by E. B. Swanson, published in January, 1927, as Information Circular 6017 of the Bureau of Mines; and of Railroad Fuel Oil Consumption in 1926, by A. H. Redfield, published in October, 1927, as Information Circular No. 6049.

- - - - - - -

Greater consumption of fuel oil in California, due to local increases in the ton-mileage of revenue-freight carried, coupled with a smaller growth in the fuel-oil consumption of Washington and Oregon and with insignificant advances in the Rocky Mountain and North Central States, served to augment the national consumption of fuel oil by railroads from 68,392,390[3] barrels in 1926 to 68,777,836 barrels in 1927, or by 0.57 per cent. This increase took place in spite of an important decline in the quantity consumed in the Atlantic States, a less important decrease in consumption in the South Central States, and of a general diminution due to greater efficiency and economy in locomotive operation. Although a general 3½ per cent decrease in revenue-freight traffic over the United States was reflected in a 5.4 per cent lower consumption of fuel of all kinds in locomotives on Class I railroads, the total amount of fuel oil burned in locomotives on Class I railroads decreased by only 1.34 per cent, from 58,563,755 barrels in 1926 to 57,781,302 barrels in 1927. This decrease was due chiefly to a lessened use of fuel oil in the Atlantic States.

During 1927 a total of 68,130,158 barrels of fuel oil was purchased by the 162 Class I, II, and III railroads included in this statement. Not only was this amount completely consumed, but 647,678 barrels in addition was drawn from stocks held in storage, so that the total consumption of fuel oil by United States railroads in 1927 amounted to 68,777,836 barrels. Stocks held by the railroads at the beginning of the year totaled 16,533,784 barrels, and at the end of the year, 15,886,106 barrels, a decrease of 3.87 per cent. Of the total consumed, 58,660,306 barrels, or 85.3 per cent, was burned directly as locomotive fuel; 10,117,530 barrels was consumed in construction and repair shops, power plants, ferry boats, and for other uses than fueling locomotives.

---

[1] - The Bureau of Mines will welcome reprinting of this article, but requests that the following footnote acknowledgment be used: "Printed by permission of the Director, U. S. Bureau of Mines. (Not subject to copyright.)"

[2] - Assistant Economic Analyst, U. S. Bureau of Mines.

[3] - Revised.

Although each of the 162 railroads used some fuel oil in its operations, comparatively few used it in any considerable quantity. Only two railroad systems purchased more than 5,000,000 barrels each during 1927, and these two consumed jointly nearly half of the fuel oil burned by railroads in the United States. Only 4 railroads purchased between 2,000,000 and 5,000,000 barrels, 18 railroads between 500,000 and 2,000,000 barrels, 18 railroads between 100,000 and 500,000 barrels, 8 railroads between 50,000 and 100,000 barrels, while the remaining 112 railroads purchased relatively unimportant amounts of fuel oil during the year.

As in 1925 and 1926, more than four-fifths of the national consumption of fuel oil by railroads was burned in the South Central States and in California. Railroads operating in these two regions consumed altogether 57,087,059 barrels of fuel oil, or 83 per cent of the 1927 total. A little over 8½ per cent was consumed in Washington and Oregon, and about 4½ per cent in the Atlantic States. The remaining 4 per cent was consumed in the North Central States and in the area adjacent to the Wyoming and Montana oil fields.

That a somewhat larger volume of revenue-freight was carried by the chief railroads operating in California and in the neighboring States of Nevada, Arizona, and western New Mexico was shown by an increase in the consumption of fuel oil in this district from 24,042,341 barrels in 1926 to 25,937,897 barrels in 1927. On Class I railroads in this region there was a corresponding increase in the total locomotive consumption of all fuel, of which fuel oil represented 73.71 per cent in 1925 and 71.67 per cent in 1927. Increased efficiency and economy of operation, however, resulted in a lower ratio between the total amount of fuel oil burned in locomotives, and the total ton-mileage of revenue freight carried. Heavy drafts on oil in storage made by one large consumer principally caused the decrease of 1,662,231 barrels in the stocks of fuel oil held by railroads in the California district.

Relatively lower prices of fuel oil and higher prices of bituminous coal caused railroads operating in Washington and Oregon to consume altogether 5,929,142 barrels of fuel oil in 1927, an increase of 5.95 per cent over the 5,595,818 barrels consumed in 1926, and of 12.06 per cent over the 5,291,603 barrels consumed in 1925. Although the total quantity of fuel burned by locomotives on Class I railroads in these States decreased 2.77 per cent from the quantity burned in 1926, because of greater economy and efficiency in operations, the consumption of fuel oil by these railroads increased 3.85 per cent in the same period. Fuel oil represented 12.39 per cent of the total fuel consumed by Class I railroads in Washington and Oregon in 1926 and 12.95 per cent of that consumed in 1927.

Greater use of fuel oil by a single railroad system, as a result of materially higher coal prices, brought about an increase in the consumption of fuel oil by railroads of the Rocky Mountain States (other than transcontinental railroads terminating in Washington and Oregon) from 2,423,783 barrels in 1926

Railroad Fuel-Oil Purchases, Stocks, and Consumption, 1927.

District	Purchases	Stocks,		Consumption		
		January 1	December 31	1927	1926	1925
California	24,275,666	7,367,553	5,705,322	25,937,897	24,042,341	24,563,663
Oregon-Washington	6,027,615*	449,801	548,274	5,929,142	5,595,818	5,291,603
Rocky Mountain	2,441,185	116,409	100,321	2,457,273	2,423,783	2,419,729
North Central	191,116	11,852	12,417	190,551	155,584	159,476
South Central	31,984,468	8,305,871	9,141,177	31,149,162	31,971,445**	32,674,904
Atlantic	3,210,108	282,298	378,595	3,113,811	4,203,419	4,351,744
	68,130,158	16,533,784	15,886,106	68,777,836	68,392,390**	69,461,119

* Of this quantity, 2,369,238 barrels was obtained from Montana and Wyoming, and the remainder chiefly from California.

** Revised.

to 2,457,273 barrels in 1927. On the other railroads of this district the use of fuel oil fell off somewhat, in accordance with a general decrease in the ton-mileage of revenue-freight carried and the general decrease in the total amount of fuel of all kinds consumed. However, fuel oil represented only 5.05 per cent of the total fuel burned by locomotives in this district in 1926, and only 5.41 per cent of the total in 1927.

As in the Rocky Mountain States, the greater use of fuel oil by a single railroad which used about one-fifth of all the fuel oil consumed in the North Central district caused the fuel oil consumption of railroads operating in central United States north of Kansas City and St. Louis to increase from 155,584 barrels in 1926 to 190,551 barrels in 1927. Other railroads in this district showed comparatively unimportant increases or decreases in their use of fuel oil. In general only about 40 per cent of the fuel oil consumed by the North Central railroads was burned in locomotives, and much of this was used for starting fires quickly rather than for the ordinary operation of locomotives. Most of the other three-fifths of the fuel oil consumed was burned in railroad shops, chiefly in forges and furnaces where high and constant heat is demanded. In this district fuel oil supplied only 0.24 per cent of the fuel requirements of locomotives on Class I railroads in 1926, and only 0.26 per cent in 1927.

Increased economy and efficiency in the burning of oil fuel, as well as a somewhat decreased revenue-freight traffic on several of the larger consumers of fuel oil in the South Central States, lowered the total amount of fuel oil consumed by railroads in central United States south of St. Louis and Kansas City, east of Albuquerque and Santa Fe, and west of Montgomery, Nashville, and Louisville from 31,971,445[4] barrels in 1926 to 31,149,162 barrels in 1927. While in general the total ton-mileage of revenue-freight hauled within the area increased 0.884 per cent from 1926 to 1927, the total tonnage of fuel burned by locomotives on Class I railroads was increased only 0.767 per cent. Of the total fuel consumed by locomotives in the South Central States, fuel oil represented 31.09 per cent in 1926 and 30.81 per cent in 1927.

Sharp decreases in both freight and passenger traffic on one railroad system which uses the major part of the fuel oil consumed in the Atlantic States caused the demand for fuel oil by railroads in the area east of the Appalachian Mountains to drop from 4,203,419 barrels in 1926 to 3,113,811 barrels in 1927. This was partly offset by the increased use of fuel oil by another railroad which doubled its purchases and trebled its locomotive consumption; but this increase in turn served only to counteract the small but general decrease in the railroad use of fuel oil which accompanied a general 8 per cent decrease in the total consumption of fuel by locomotives and a general 5 per cent falling-off in the ton-mileage of revenue freight hauled in the Atlantic States. However, fuel oil is of little general importance in the operation of trains in the Atlantic States, representing only 0.84 per cent of the total fuel burned by locomotives in 1926, and only 0.60 per cent in 1927. Only 45 per cent of the fuel oil consumed by railroads in the Atlantic States in 1926 and in 1927 was used in the operation of locomotives. The greater part of the fuel was burned in furnaces and forges in railway construction and repair shops, in power plants, and for other uses than driving locomotives.

---

[4] - Revised.

From 15,577,670 barrels in 1906 the consumption of oil as a locomotive fuel has grown in 21 years to an amount nearly four times as large. Although complete statistics of fuel oil burned by railroads prior to 1925 are not available, the Interstate Commerce Commission has compiled and published figures for a number of years showing the quantity of fuel oil burned in locomotives operated by Class I railroads. This quantity represented in 1927 about 84 per cent of the total oil consumed as railroad fuel, the remainder being burned in shops, power plants, and vessels, and in locomotives operated by Class II and III railroads. With these figures is a statement of the number of oil-burning locomotives owned on Class I railroads.

Fuel Oil Consumed by Locomotives (Class I Railroads Only)

Year	No. of Oil-Burning Locomotives Available for Service	Barrels of Oil Consumed
1908	2,354	16,889,100
1909	2,690	19,905,335
1910	2,981	23,817,346
1911	3,565	29,748,845
1912	4,052	33,605,598
1913	4,055	33,004,815
1914	4,140	31,093,266
1915	***	32,830,187
1916	***	38,208,516
1917	***	42,973,555
1918	***	39,022,785
1919	***	37,763,361
1920	***	45,944,539
1921	***	39,558,181
1922	***	43,526,787
1923	6,962	55,580,138
1924	7,373	58,949,918
1925	7,112	58,519,685
1926	7,304	58,563,755
1927	7,421	57,781,302

*** Not available.

In 1927 the proportion of fuel oil burned by Class I railroads to the total amount of fuel of all kinds consumed, 10.86 per cent, almost equaled the maximum of 10.87 per cent attained in 1924. In the following table the fuel oil consumed has been converted, at the ratio used by most railroads (168 gallons to a short ton), to the number of short tons (2,000 pounds) of bituminous coal which theoretically represent an equivalent heating value, without considering the relative operating efficiencies of the various fuels consumed.

Comparison of Oil With Other Fuels Consumed (Class I Railroads Only)

Year	Fuel Oil Converted to Fuel Equivalent in Short Tons of Bituminous Coal	Total Short Tons of Fuel Consumed by Locomotives	Per Cent Oil to Total Fuel Consumed
1917	10,743,389	150,230,647	7.15
1918	9,755,696	148,122,435	6.58
1919	9,440,840	132,620,935	7.12
1920	11,486,135	151,405,712	7.58
1921	9,889,545	121,006,242	8.17
1922	10,881,697	127,213,343	8.55
1923	13,895,034	148,921,714	9.32
1924	14,737,480	135,617,320	10.87
1925	14,629,921	135,419,983	10.80
1926	14,640,939	140,425,844	10.43
1927	14,445,326	133,061,857	10.86

While in general the importance of fuel oil in the national fuel supply for locomotives has shown a marked increase during the last 11 years, the exact proportion of fuel oil to the total fuel has fluctuated somewhat from year to year, primarily because of differences in local conditions. In each region the quantity of fuel oil used each year varies with the relative costs of oil and coal, the volume of traffic, changes on particular railroads from oil-burning to coal-burning or the reverse, and the efficiency of burning. Consequently it is difficult to generalize about oil-burning on railroads over the United States as a whole.

Through newer and improved engines which consumed relatively less fuel, through equipping older locomotives with newer and improved devices for saving fuel, through more complete loading of cars, through improvements in the roadway, and especially through the cooperation of employees, it is calculated that 267,376 barrels of fuel oil was saved in freight service on the Pacific Lines of the Southern Pacific Railway, in comparison with the rate at which fuel oil was consumed in freight service during 1926. However, an increased consumption of .009 gallon per car-mile in passenger service, amounting altogether to 22,905 barrels, reduced the saving in fuel oil consumed on the Pacific Lines of the Southern Pacific Railway to a net total of 244,471 barrels. The increasing efficiency with which oil has been burned as a locomotive fuel during the last 16 years is indicated by the following table showing the unit consumption of oil, in freight and passenger service, on the two main divisions of the Southern Pacific system.

Year	Pacific Coast Lines Southern Pacific Gallons of oil per		Southern Pacific Lines in Texas and Louisiana Gallons of oil per	
	1,000 Gross ton-Miles* of Freight	Passenger Car Mile	1,000 Gross ton-Miles* of Freight	Passenger Car Mile
1912	16.63	1.37	-----	-----
1913	15.96	1.27	-----	-----
1914	15.50	1.20	-----	-----
1915	14.62	1.21	-----	-----
1916	14.56	1.22	-----	-----
1917	14.61	1.19	-----	-----
1918	14.18	1.18	-----	-----
1919	13.16	1.10	-----	-----
1920	14.42	1.11	11.71	1.17
1921	13.10	1.09	11.63	1.09
1922	12.85	1.06	11.35	1.07
1923	12.42	1.05	10.85	1.05
1924	11.47	1.00	10.22	.95
1925	11.15	.99	10.53	.93
1926	11.94	.945	10.38	.88
1927	11.56	.954	9.71	.84

* The term gross ton-miles includes the total weight in short tons of freight, cars, fuel and water, locomotive and tender, multiplied by the number of miles hauled.

Although figures are not available to show the saving in fuel oil due to increased economy and efficiency on other railroad systems, a comparison of the total locomotive consumption of fuel oil with the total ton-mileage of revenue-freight moved in the various sections of the United States shows beyond a doubt that in general less fuel oil was required to move a ton of freight one mile in 1927 than in 1926.

A minor and as yet comparatively unimportant use of fuel oil by railroads in the United States is in the operation of oil-electric locomotives, in which an oil-burning Diesel engine operates a generator and charges a storage battery unit which supplies power. During 1927 8 oil-electric locomotives were placed in service, as compared with 15 in 1926, and 6 in 1925. Three more were delivered by the builders to railroads during the first four months of 1928, and five others were under construction on June 30, 1928. Of the 37 locomotives of this type known to have been sold and delivered by the chief manufacturers from October, 1925, to June 30, 1928, 12 were employed by railroads in switching and freight service in and around New York City; 5 in similar service in and around Philadelphia; 3 in and around Chicago; 3 were in use at steel mills of the North Central area; 2 in Western copper mines and smelters; 1 in a California lumber camp; and the other 8 were variously used by railroads and manufacturing plants.

Grateful acknowledgment is made to the railroads for information furnished as to their oil-burning practices and to the Interstate Commerce Commission and the Railroad Commission of Texas for permission to examine reports filed by the railroads. The aid given by the Bureau of Railway Economics in Washington in compiling the number of oil-burning locomotives in use from 1913 to 1927 and in furnishing other information is greatly appreciated.